



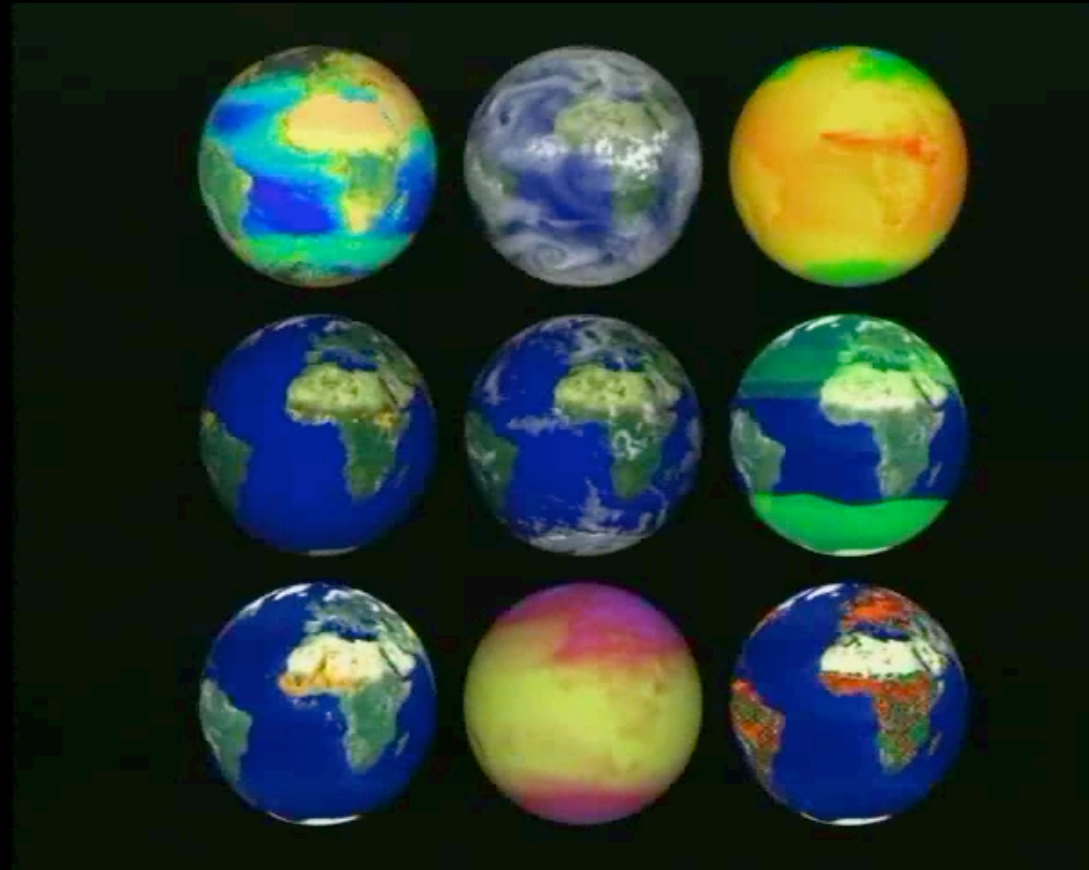
# NASA: Earth Science Overview

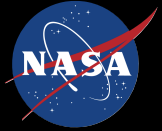
Steven Platnick

NASA Goddard Space Flight Center

presented to representatives of Tunisian  
Ministry of Agriculture & Remote Sensing  
Center for N. African States

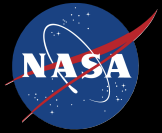
28 May 2013





# The Questions ...

- How does the Earth work as a system of interconnecting parts?
- How is the Earth's environment is changing?
- How do humans affect the environment and climate, and what are the future consequences?

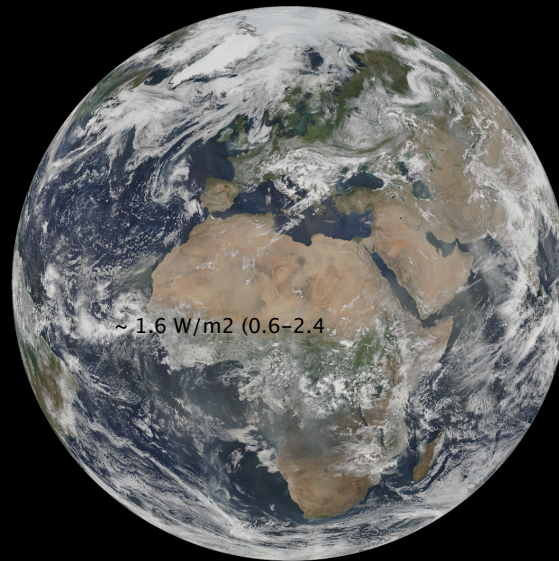


# The Climate Questions ...

**GHG's** (CO<sub>2</sub>,  
CH<sub>4</sub>, ...),  
**Aerosols**  
(direct &  
indirect  
[largest  
unc.]), ...

Forces acting on  
the Earth system

$\sim 1.6 \text{ W/m}^2$   
(0.6–2.4)

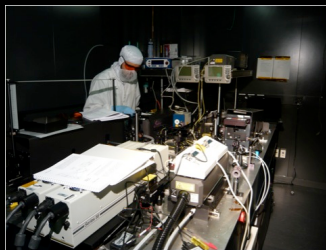


Earth system  
responses

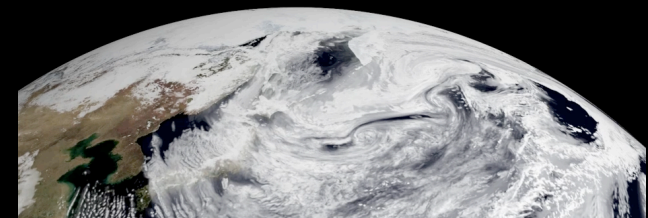
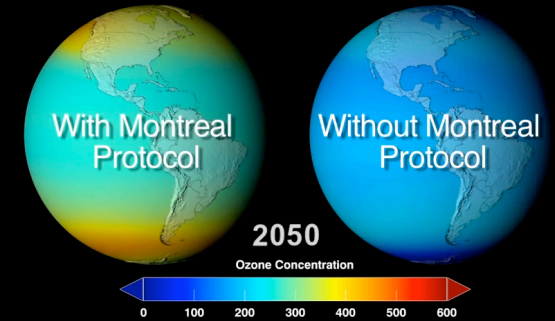
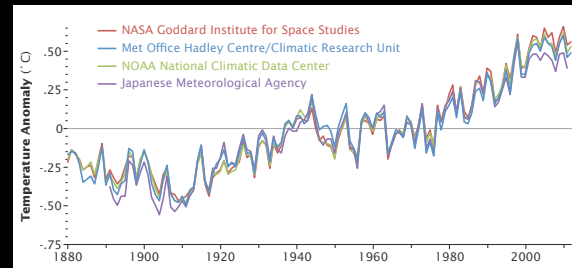
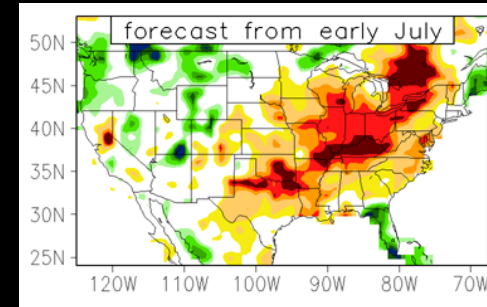
**IMPACTS**

Feedbacks (in order of largest uncertainty):  
cloud, lapse rate/water vapor, snow/ice albedo

## Measurements



## Modeling





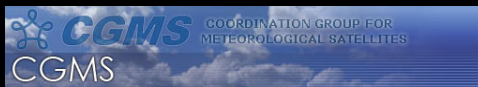


# NASA Science Efforts Include ...

- **Measurements**
  - instruments on satellites, aircraft/balloons, and the ground
- **Modeling**
  - physical processes, climate, weather
- **Communication**
  - free and open data access
  - scientists, public, stakeholders

# International Efforts in Satellite Observations of Climate

- Efforts of all countries are needed to provide needed breadth, resilience, and innovation.
- Space-based perspective provides unequalled vantage point for observing Earth systems.
- Cooperation among nations, including data sharing calibration/ validation, and assessment, enhances value of all nations' efforts.
- Satellite data can support both long-term climate and near-term operational requirements. Can improve quality of life for all the world's citizens.
- Numerous entities and mechanisms exist that are facilitating this coordination.



National Aeronautics and Space Administration

## Airborne Science Program

Observing Platforms for Earth System Science Investigations



WB-57



Global Hawk



ER-2



G III



Learjet



DC-8



P-3



S-3B



B-200



Twin Otter

www.nasa.gov



GLOBAL HAWK



ER-2



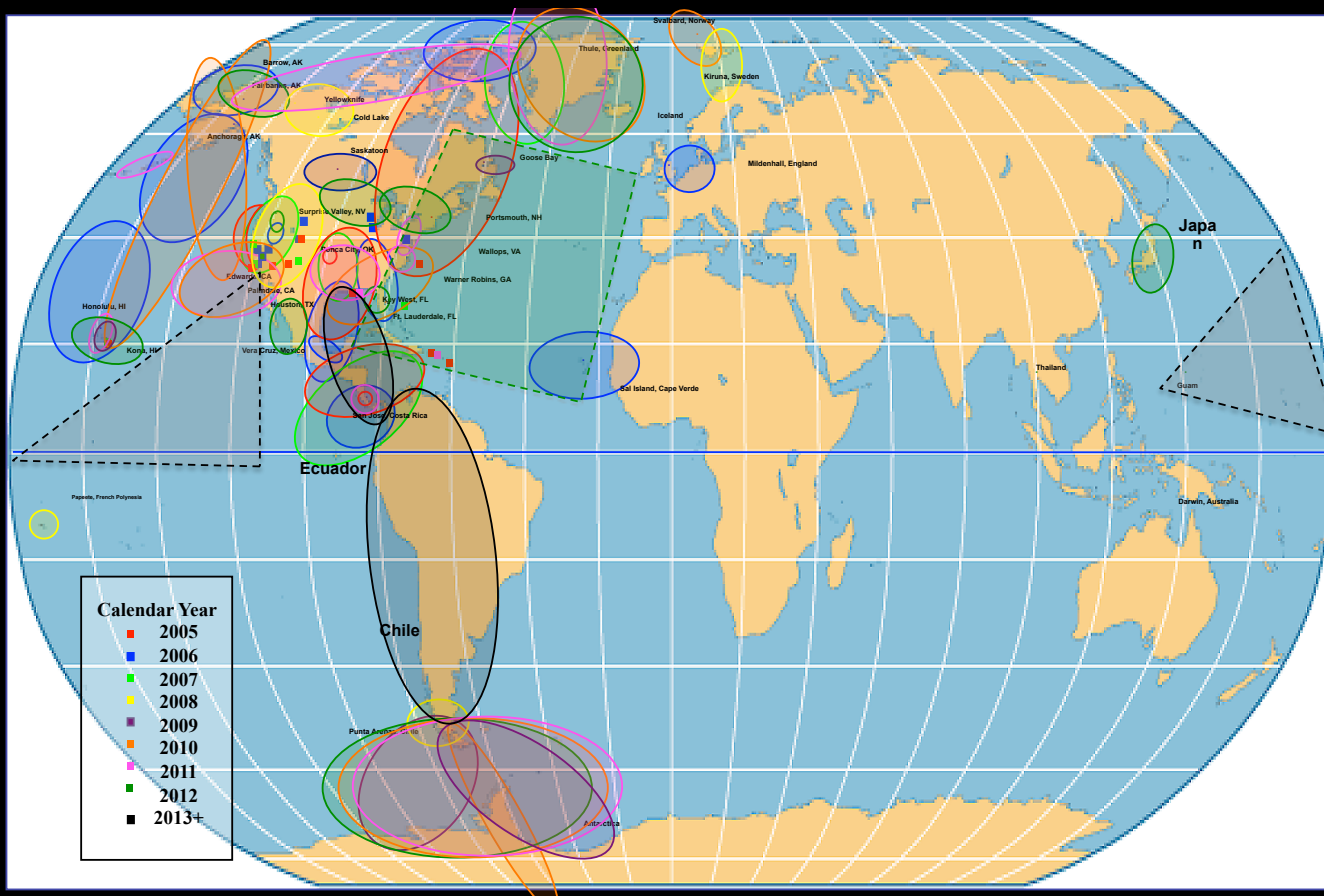
WB-57



ER-2

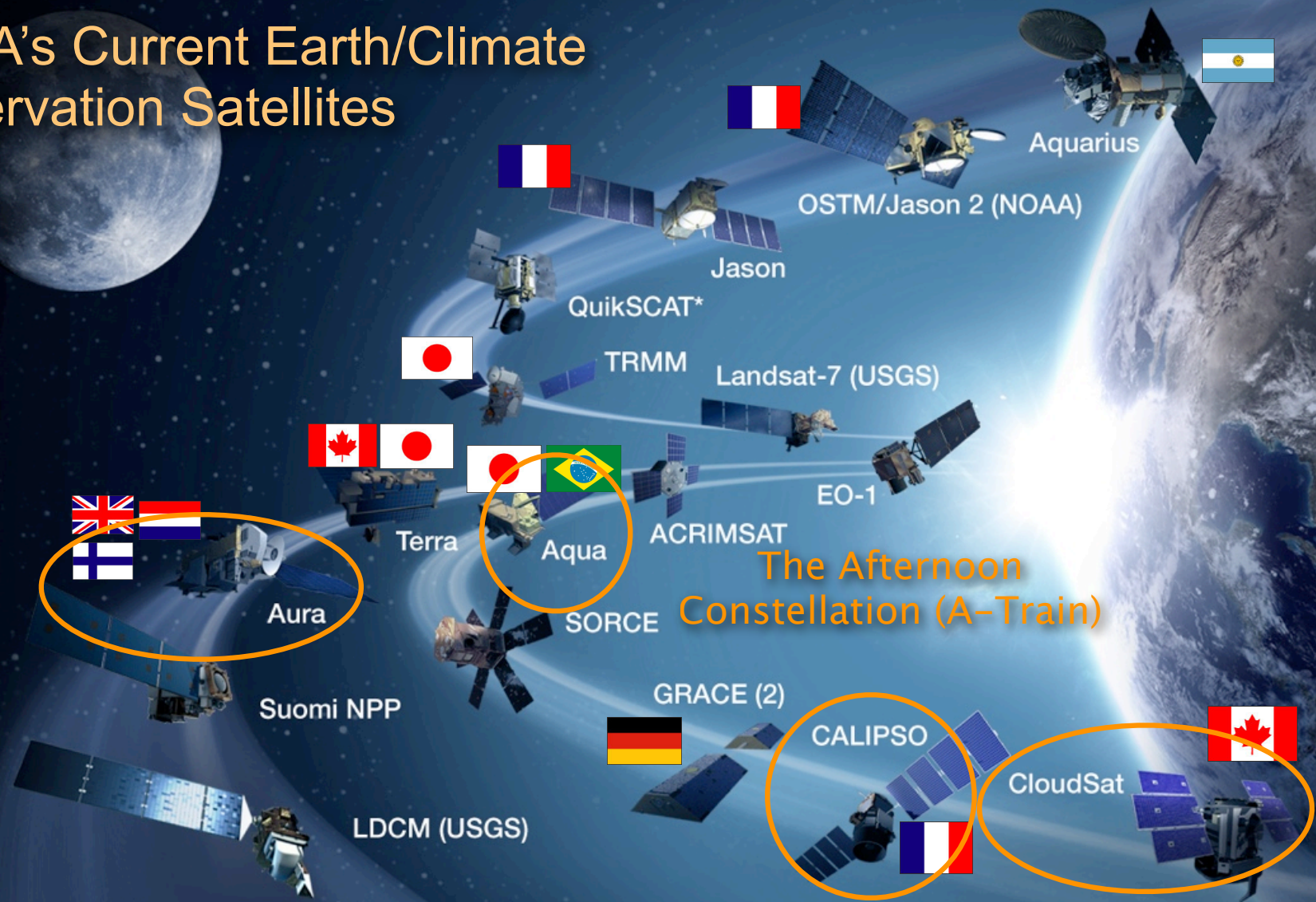


# NASA Earth Science 2005–2013 Airborne Campaigns

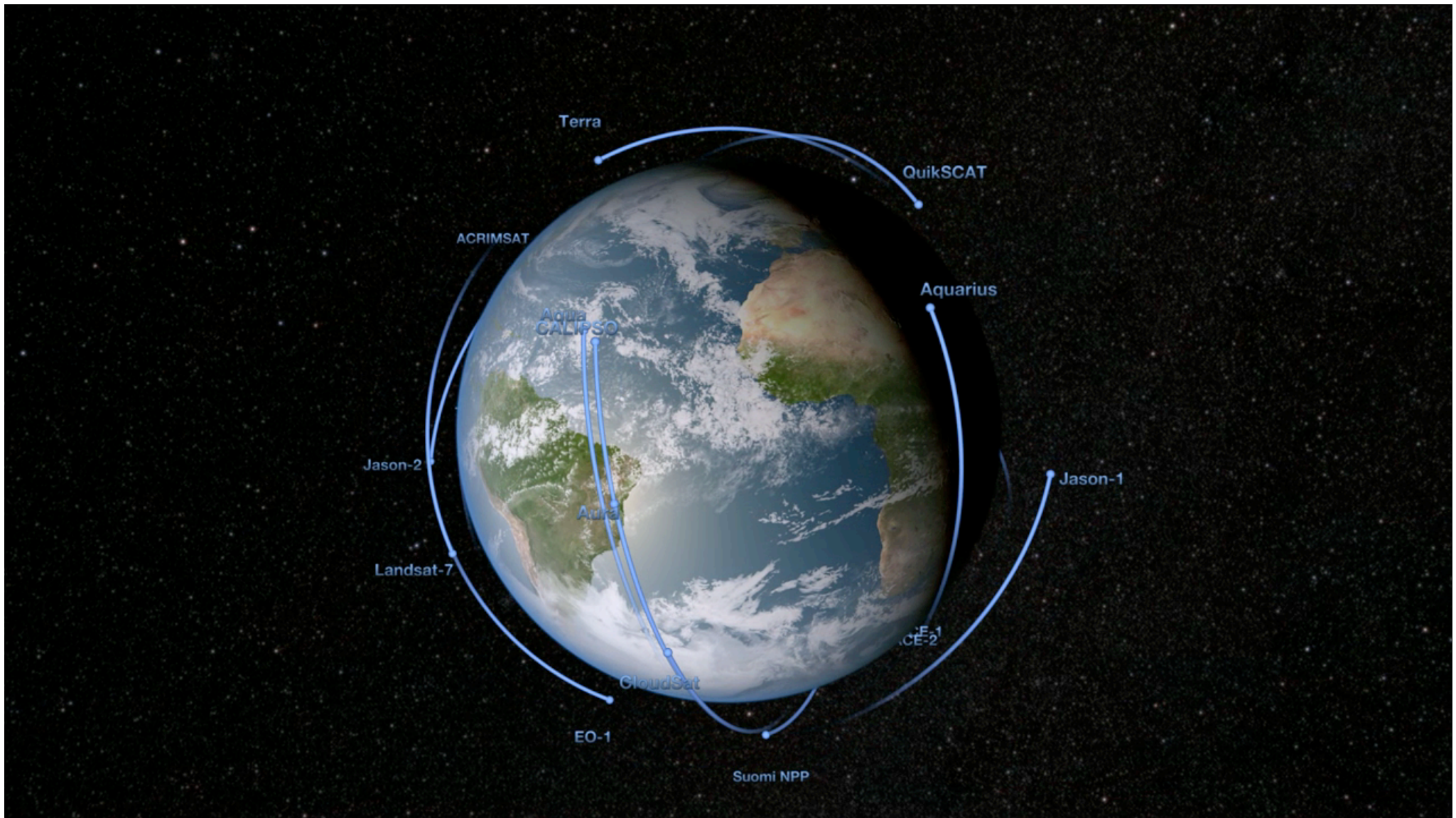




# NASA's Current Earth/Climate Observation Satellites

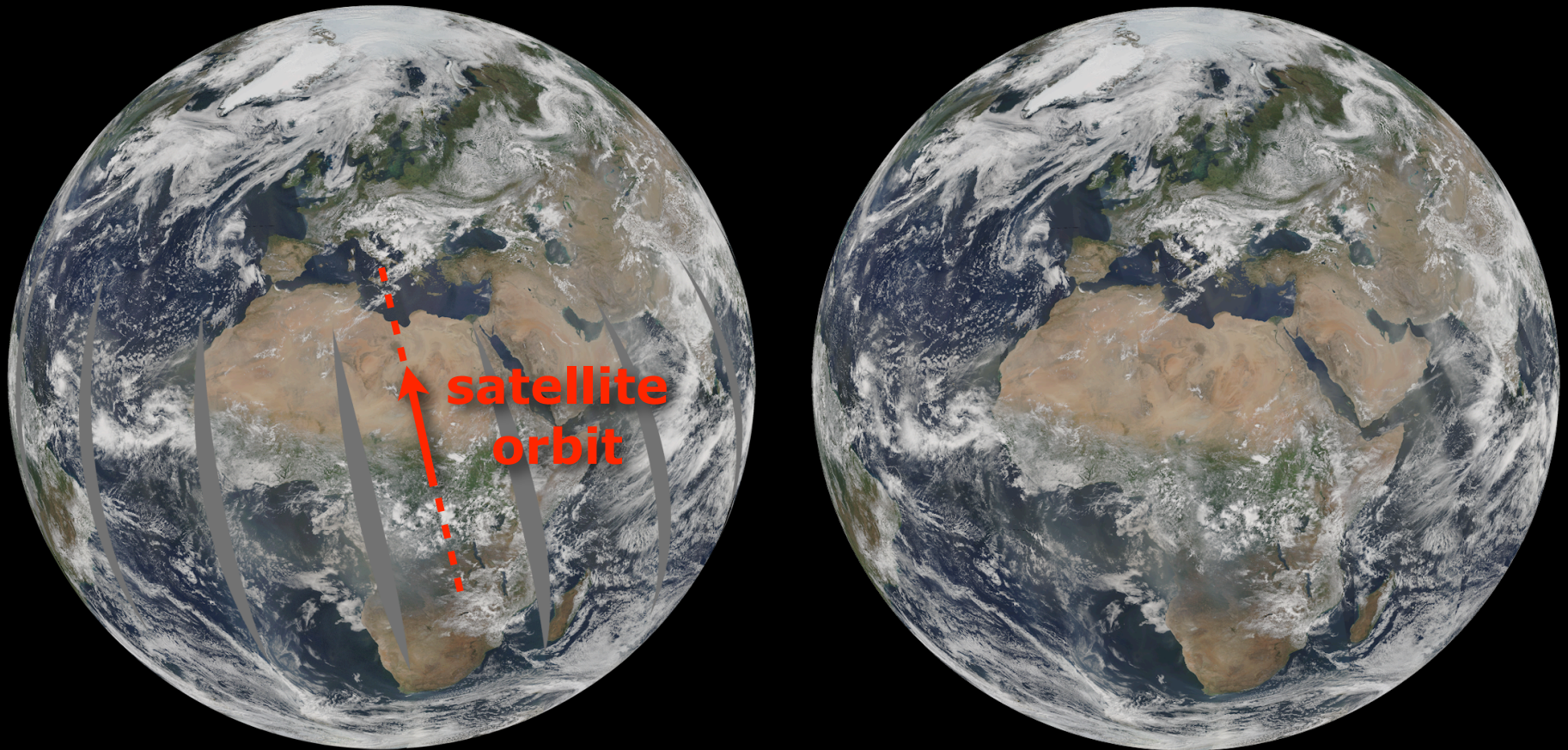






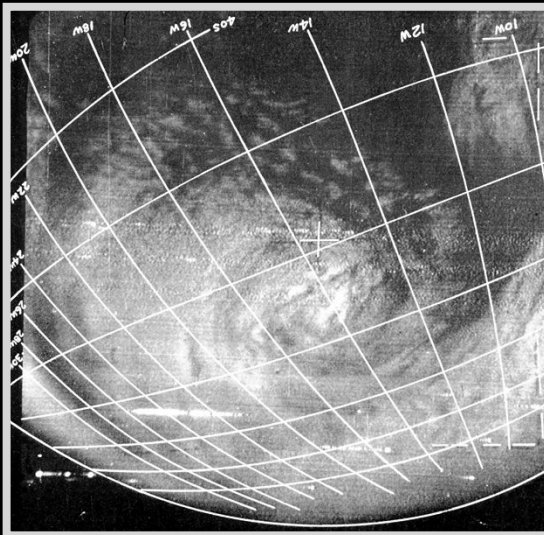


Sun Synchronous Polar Orbits:  
Aqua MODIS imager true color composite (2330 km swath)

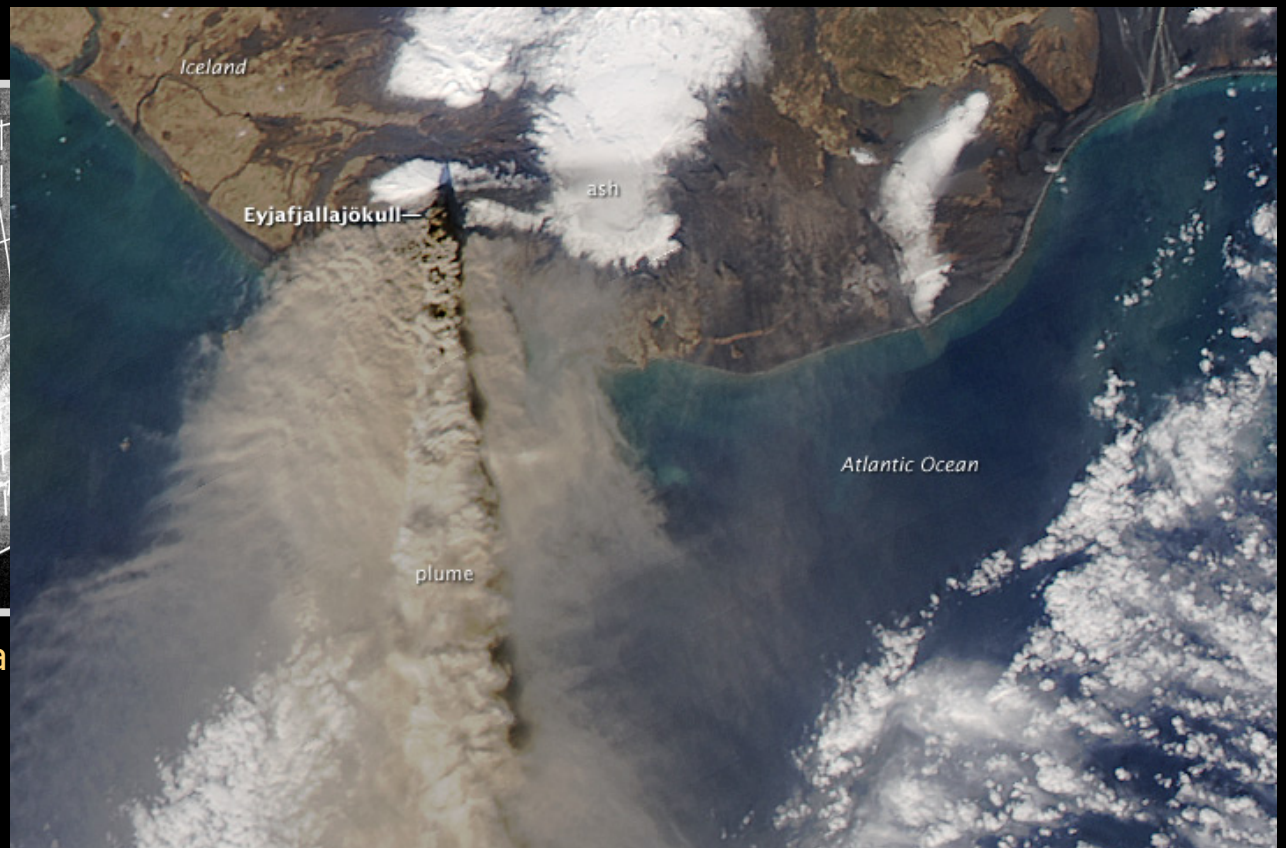




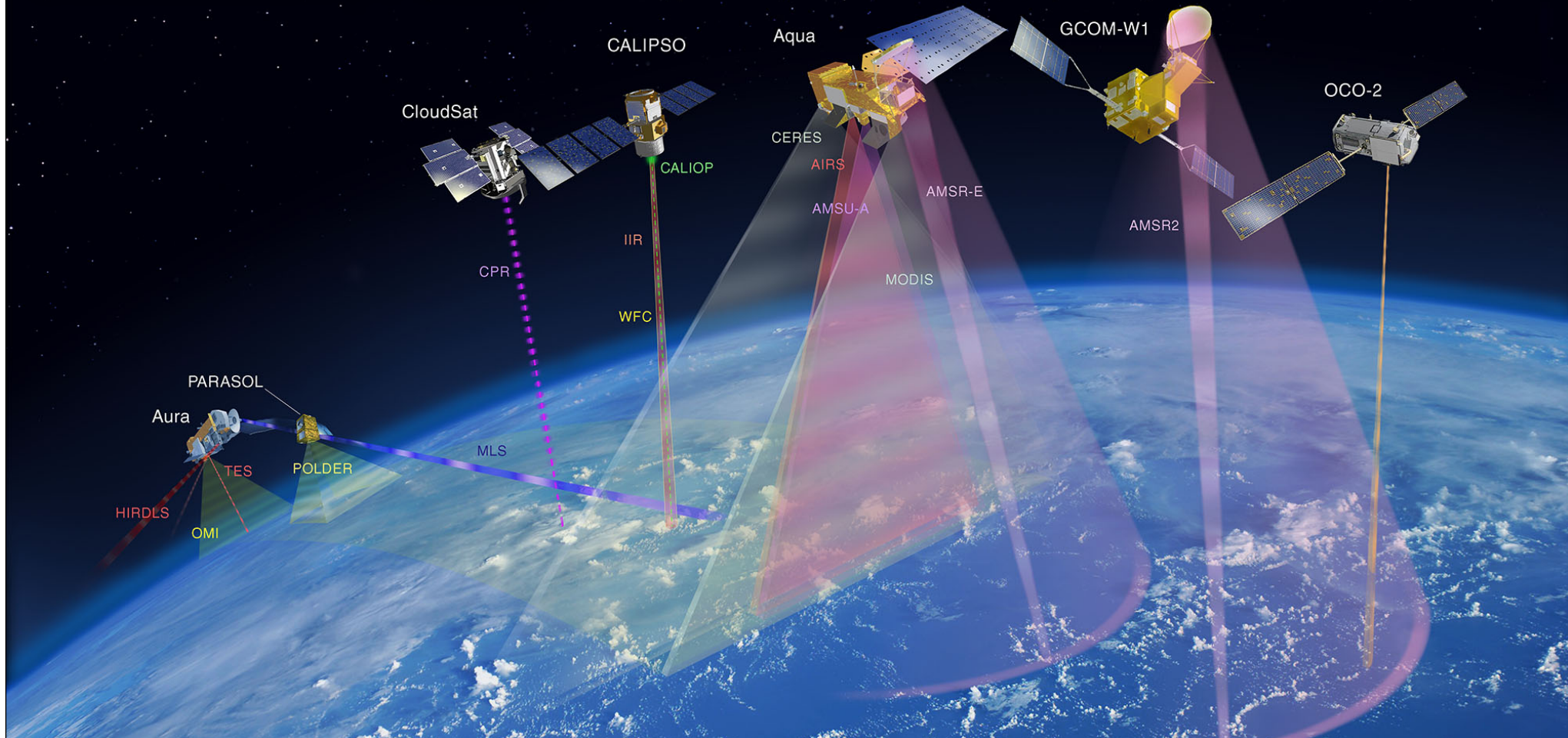
# Earth Observations: Then and Now



TIROS (Television and Infra  
Observation Satellite)  
S. Atlantic Cyclone  
July 1961



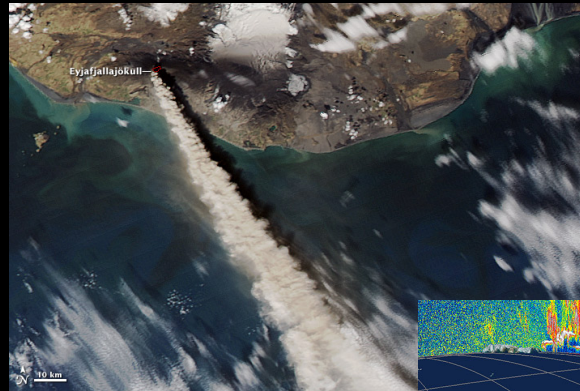
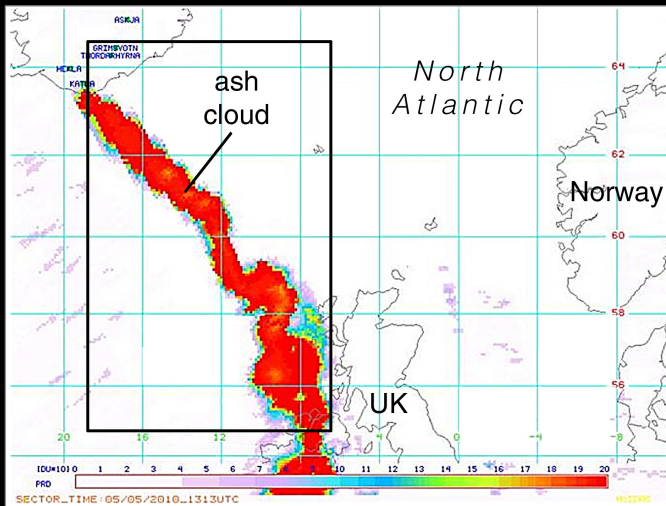
# NASA's International Afternoon Constellation (A-Train)





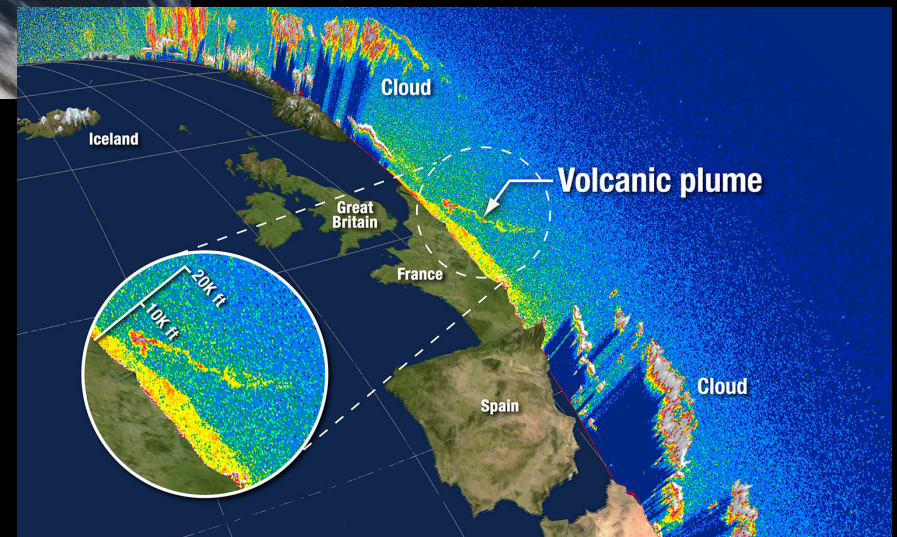
# NASA's International Afternoon Constellation (A-Train): Eyjafjallajökull

OMI SO<sub>2</sub>



MODIS true-color image  
10 May 2010

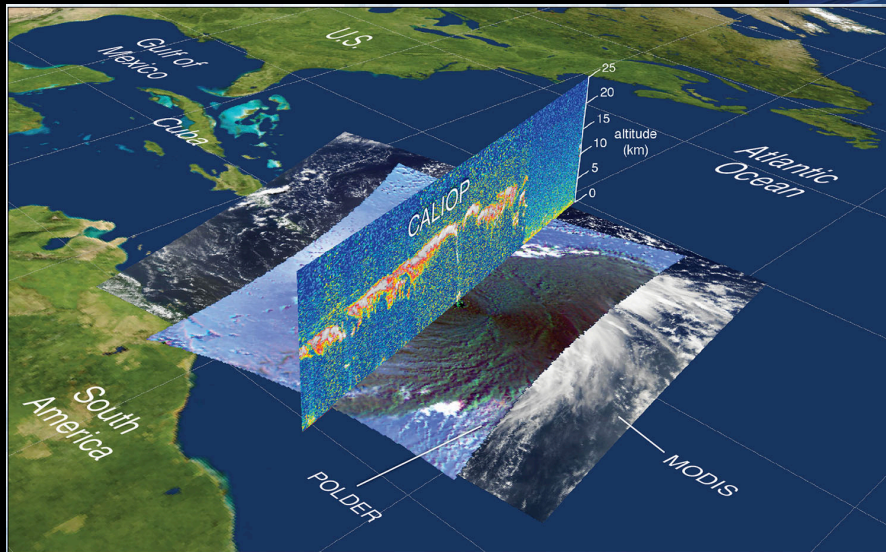
CALIPSO  
lidar



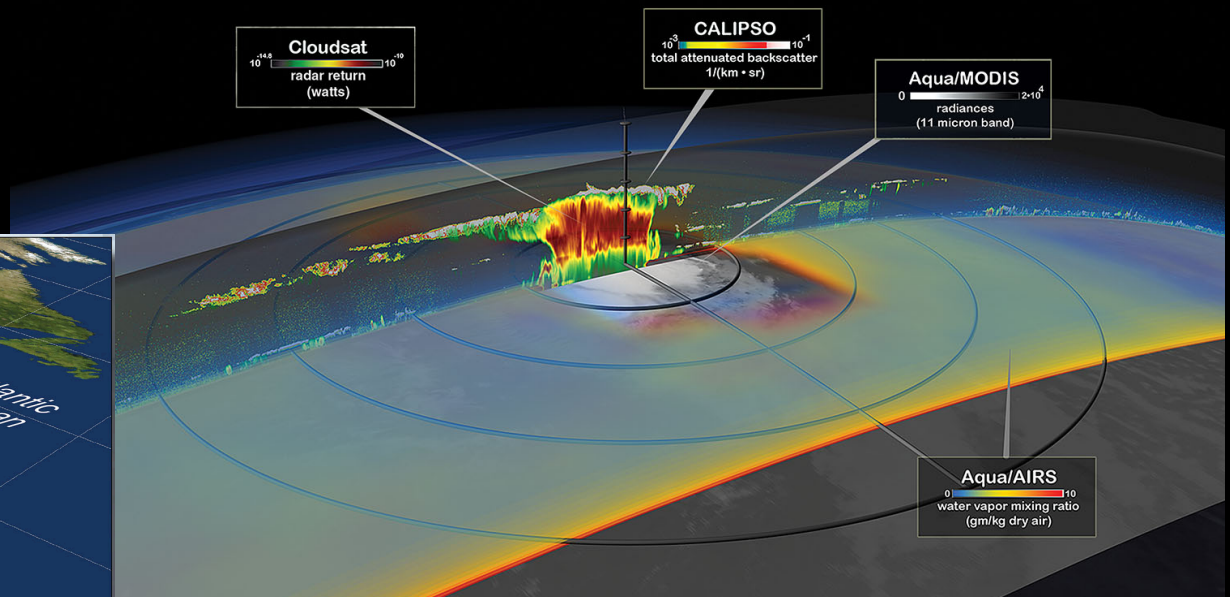


# NASA's International Afternoon Constellation (A-Train): Tropical storms

Hurricane Bill (19 Aug 2009)  
MODIS + POLDER + CALIOP lidar

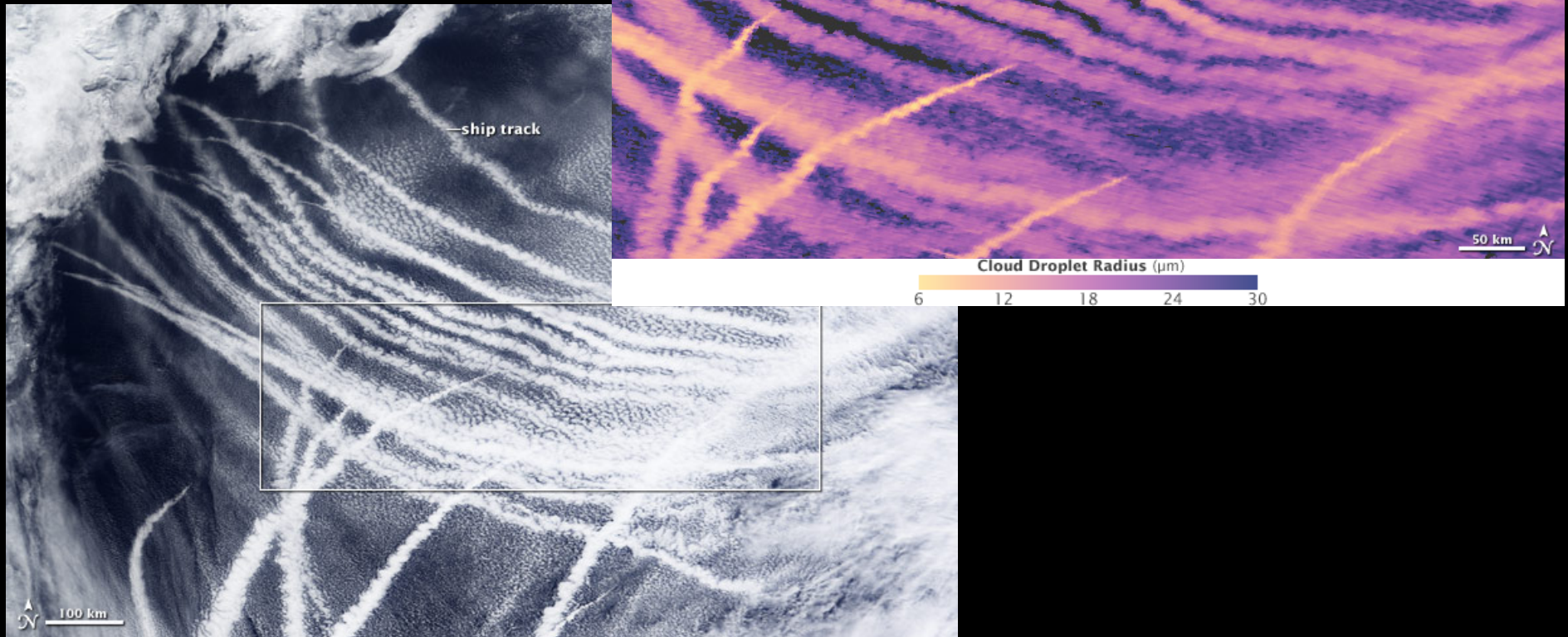


TS Debby (24 Aug 2006)  
MODIS IR + AIRS H<sub>2</sub>O + CloudSat radar + CALIOP lidar



# NASA's International Afternoon Constellation (A-Train): Aerosol Indirect Effect (AIE)

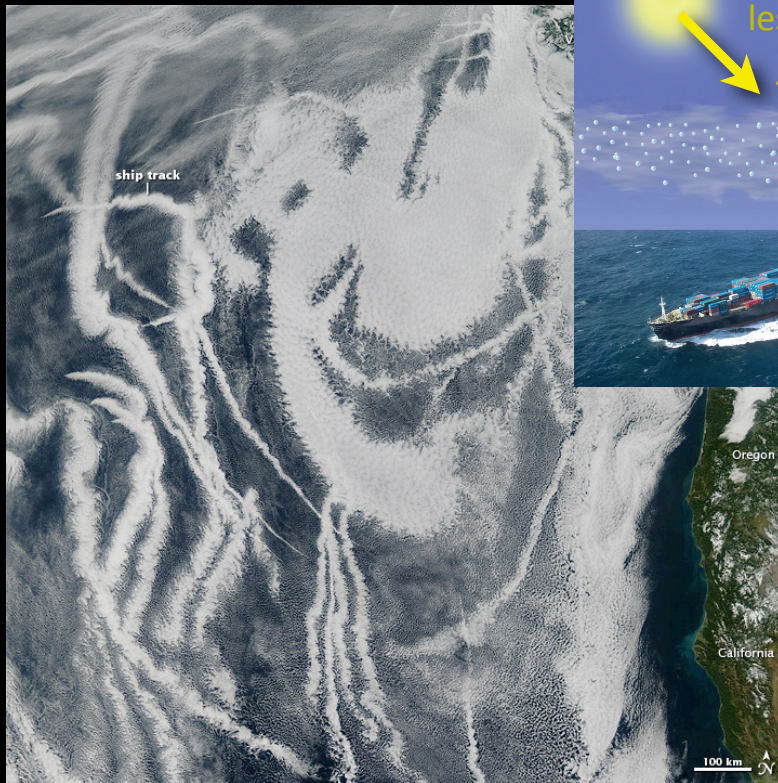
Ship Track off west coast of U. S.  
(4 March 2009): MODIS



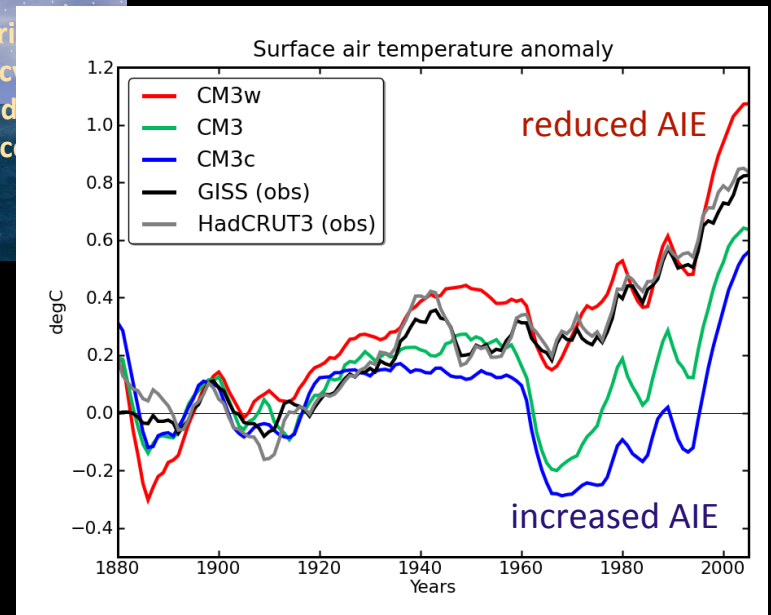


# NASA's International Afternoon Constellation (A-Train): Aerosol Indirect Effect (AIE)

Ship Track off west coast of U. S.  
(15 Jan 2013): MODIS



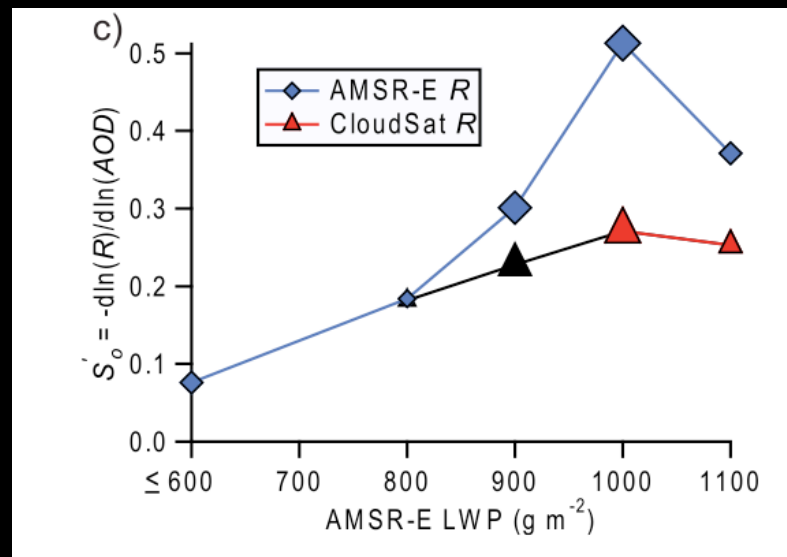
Three 20<sup>th</sup> century experiments for NOAA GFDL climate model: all achieve radiation balance, only difference is strength of AIE (autoconversion threshold size).



Golaz et al., 2013

# NASA's International Afternoon Constellation (A-Train): Aerosol Indirect Effect (AIE)

relative change  
in precipitation rate  
vs. Aerosol Optical Depth  
(AOD)

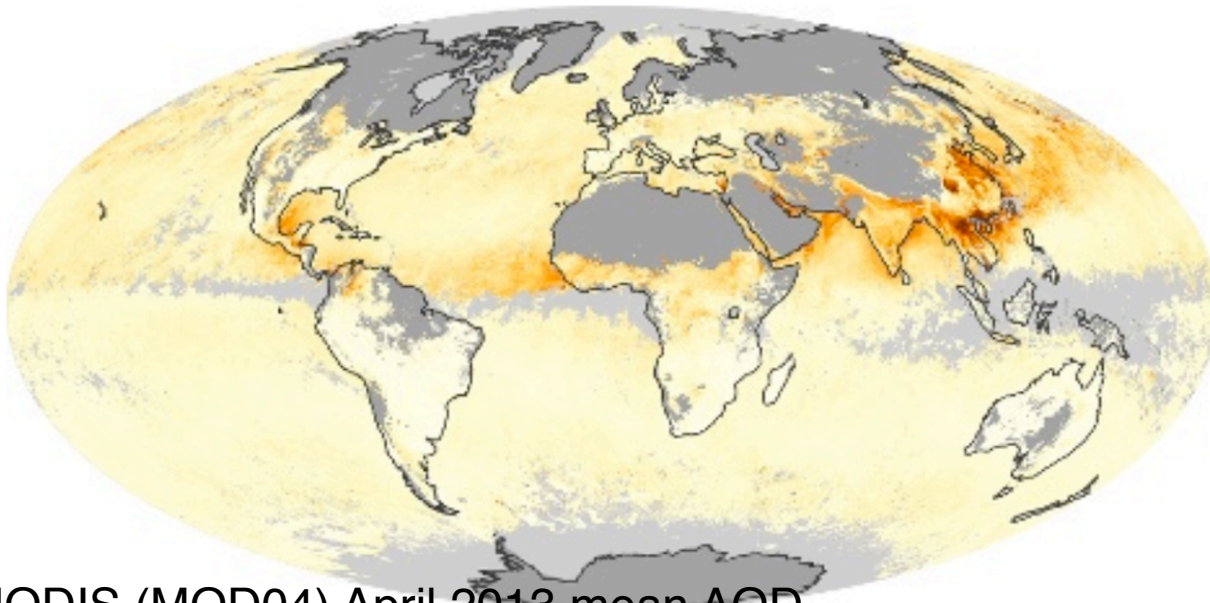


AMSR-E (Aqua satellite) Liquid Water Path (LWP)  
CloudSat precip. detection for  
Trade Cu clouds

Sorooshian et al. On the precipitation susceptibility of clouds to aerosol perturbations. Geophys. Res. Lett. (2009) vol. 36 (13) pp. 1-5

# NASA's International Afternoon Constellation (A-Train): Aerosol Direct Effect

Aerosol Optical Depth

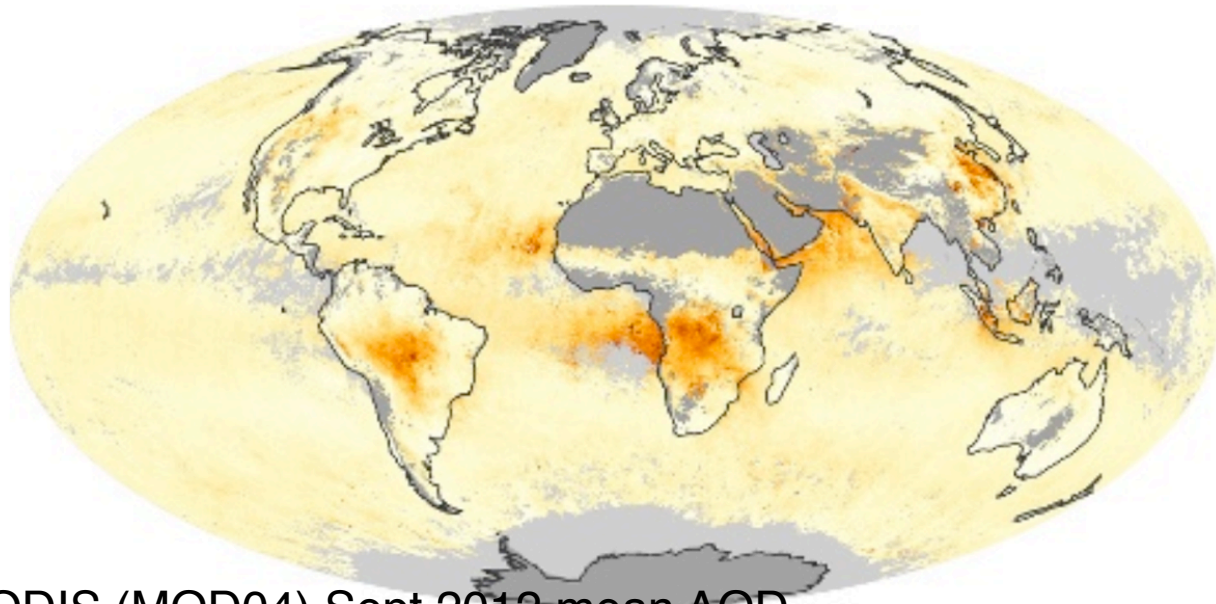


MODIS (MOD04) April 2013 mean AOD



## NASA's International Afternoon Constellation (A-Train): Aerosol Direct Effect

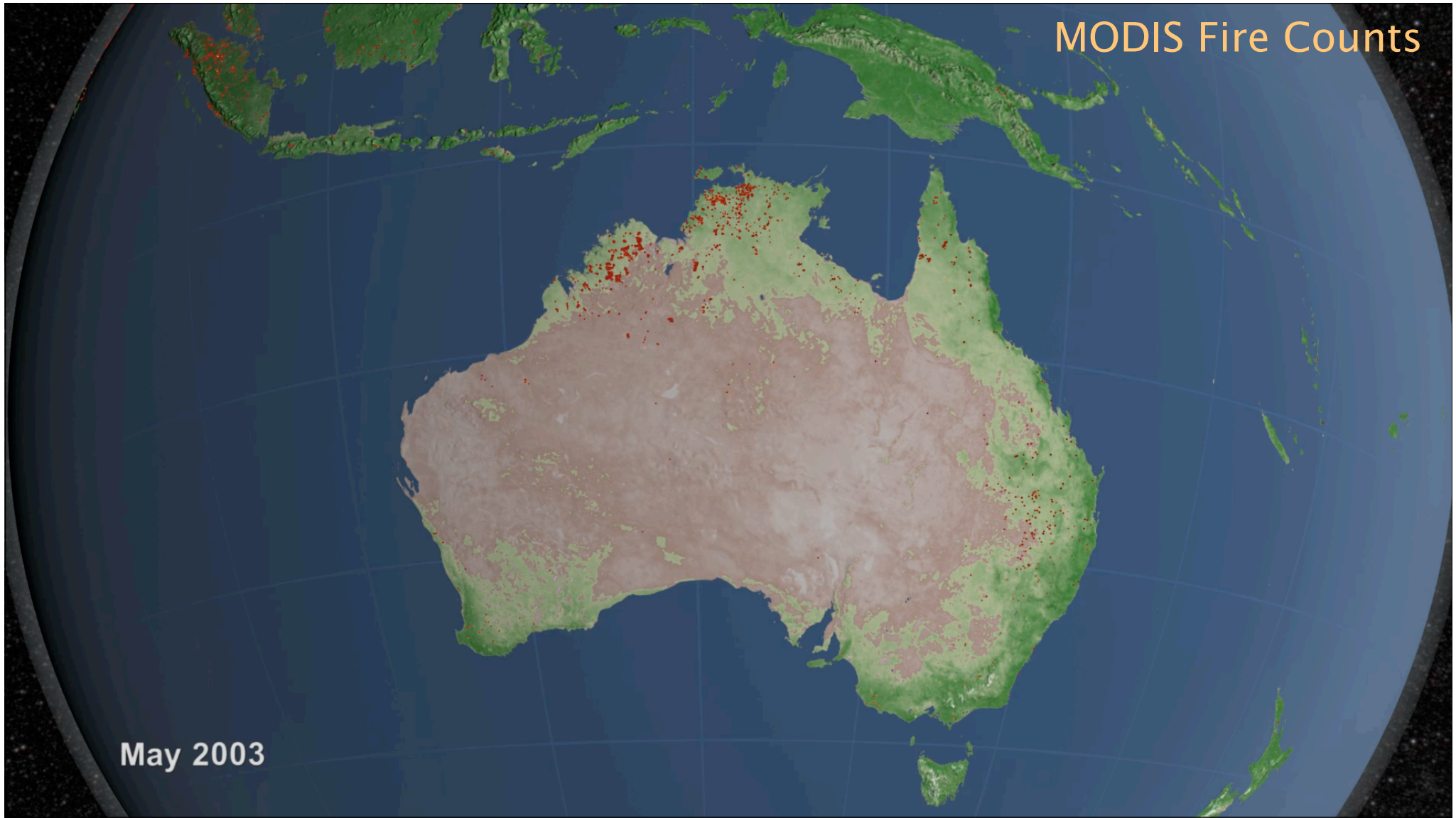
Aerosol Optical Depth



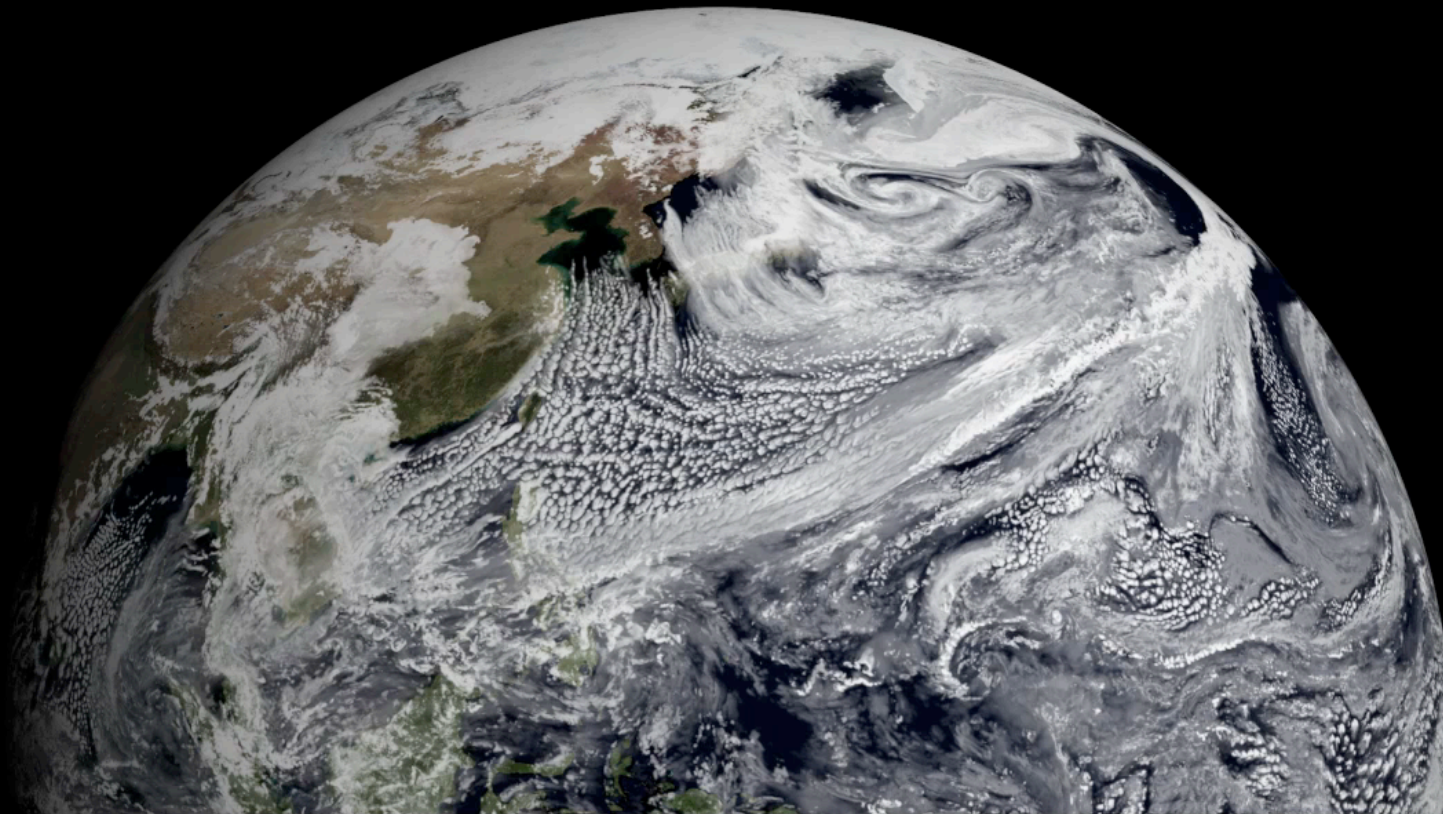
MODIS (MOD04) Sept 2012 mean AOD

# MODIS Fire Counts

May 2003



NASA GSFC GMAO GEOS-5, 3.5 km, 2 January 2009



## Useful Links

NASA LANCE (Land Atmo. Near Real-time Capability for EOS):  
MODIS, OMI, AIRS, MLS

[earthdata.nasa.gov/data/near-real-time-data](https://earthdata.nasa.gov/data/near-real-time-data)

Many of the visualizations and images shown can be found at:

[svs.gsfc.nasa.gov](https://svs.gsfc.nasa.gov)

&

[earthobservatory.nasa.gov](https://earthobservatory.nasa.gov)